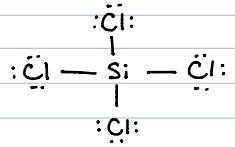
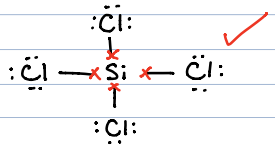
1. $SiCl_4$

① Lewis structure

- Total v.e⁻ = 32
- Skeleton + octets



- remaining = 32 − 32 = 0 (Total v.e⁻ − used v.e⁻)
- Tagging



VSEPR formula: AX_4

② Identify the number of σ bonds and lone pairs on central atom.

- # σ bonds = 4
- # lone pairs on central atoms = 0

③ Identify # of hybrid orbitals we need.

- # σ bonds + # lone pairs = 4 + 0 = 4

④ What happens:

Si

ground state: 3s (↑↓) 3p (↑ ↑) — σ σ

need 4 single electrons to accomodate 4 σ bonds.

So: NEED to excite

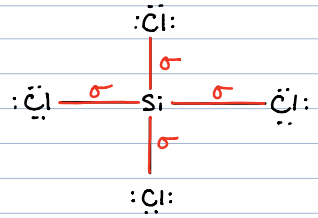
excited state: 3s (↑) 3p (↑ ↑ ↑) — σ / σ σ σ

*need to hybridize the orbitals containing an e⁻ that will form a σ bond. Here: s + p + p + p

hybridization state: sp^3 (↑ ↑ ↑ ↑) — σ σ σ σ

* Each box is an sp^3 orbital

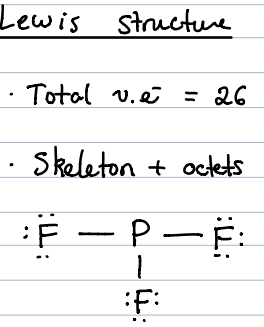
* Where are the σ bonds?



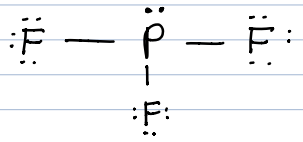
2. PF_3

① Lewis Structure

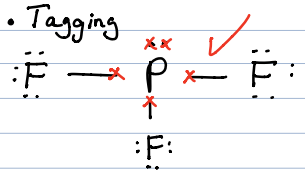
- Total v.e⁻ = 26
- Skeleton + octets



- remaining = 26 − 24 = 2



- Tagging



VSEPR formula: AX_3E_1

② Identify the number of σ bonds and lone pairs on central atom.

- # σ bonds = 3
- # lone pairs on central atom = 1

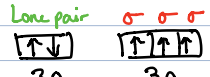
③ Identify # of hybrid orbitals we need.

- # σ bonds + # lone pairs = 3 + 1 = 4

④ What happens:

P

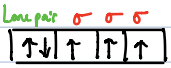
ground state: Lone pair | σ σ σ



- need 3 single electrons to accomodate 4 σ bonds.
- No need to excite

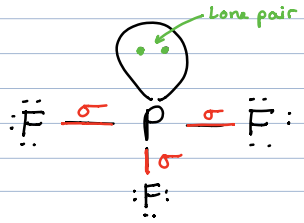
- Still need to hybridize orbitals that contain Lone pair electrons AND σ bond electrons
Here: s + p + p + p

hybridization state: Lone pair | σ σ σ



* Each box is an sp^3 orbital

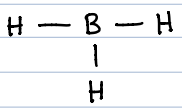
* Where is the lone pair and where are the σ bonds?



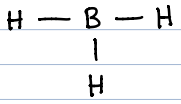
3. BH_3

① Lewis Structure

- Total v.e⁻ = 6
- Skeleton + octets



- remaining = 6 − 6 = 0
- tagging



VSEPR formula: AX_3

② Identify the number of σ bonds and lone pairs on central atom.

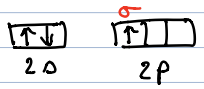
- # σ bonds = 3
- # lone pairs on central atom = 0

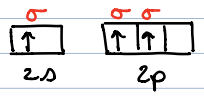
③ Identify # of hybrid orbitals we need.

- # σ bonds + # lone pairs = 3 + 0 = 3

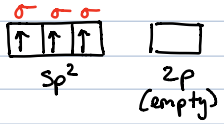
④ What happens:

B

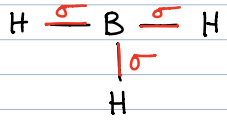
ground state: 

excited state: 

* Combining: p + p + p

hybridized state: 

* Where are the σ bonds?



4. H_2O

① Lewis structure

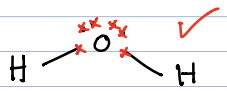
· Total v.e⁻ = 8

· Skeleton + octets

H — O — H

· remaining = 8 − 4 = 4

· tagging



VSEPR formula: AX_2E_2

② Identify the number of σ bonds and lone pairs on central atom.

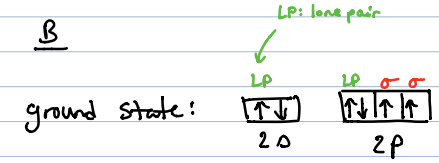
- # σ bonds = 2
- # lone pairs on central atom = 2

③ Identify # of hybrid orbitals we need.

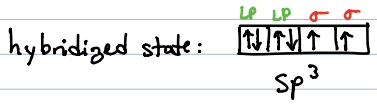
- # σ bonds + # lone pairs = 2 + 2 = 4

④ What happens:

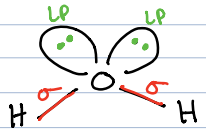
B



* no need to excite, we have enough electrons for σ bonding



* where are the lone pairs and where are the σ bonds?

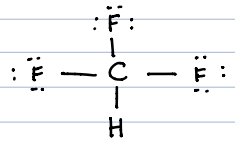


5. CHF_3

① Lewis structure

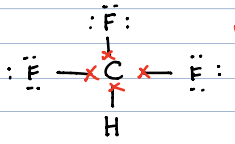
· Total v.e⁻ = 26

· Skeleton + octets



· remaining = 26 − 26 = 0 (Total v.e⁻ − used v.e⁻)

· Tagging



VSEPR formula : AX_4

② Identify the number of σ bonds and lone pairs on central atom.

- # σ bonds = 4
- # lone pairs on central atom = 0

③ Identify # of hybrid orbitals we need.

- # σ bonds + # lone pairs = 4 + 0 = 4

④ What happens :

Si

ground state: $\uparrow\downarrow$ (3s) $\sigma\sigma$ $\uparrow\uparrow|\uparrow|$ (3p)

excited state: σ $\uparrow$ (3s) $\sigma\sigma\sigma$ $\uparrow|\uparrow|\uparrow$ (3p)

hybridization state: $\sigma\sigma\sigma\sigma$ $\uparrow|\uparrow|\uparrow|\uparrow$ (sp^3)

* Where are these σ bonds ?